(12) UK Patent Application (19) GB (11) 2 186 512 (13) A

(43) Application published 19 Aug 1987

(21) Application No 8703911

(22) Date of filing 19 Feb 1987

(30) Priority data

(31) 8604127 (32) 19 Feb 1986 (33) GB

(71) Applicant
Alfred Brian Gardner,
2 Broadlands Close, London N6

(72) Inventors
Dennis Blakelock,
David Edgerley

(74) Agent and/or Address for Service
E. Eder, 48 Green Lane, London NW2AH

(51) INT CL^4
B24B 3/30 // 3/33

(52) Domestic classification (Edition I)
B3D KB

(56) Documents cited
GB 1233524
GB 0639043
GB 0431046
GB 0306887
GB 0239296

(58) Field of search
B3D
Selected US specifications from IPC sub-class B24B

(54) **Drill sharpening apparatus**

(57) Sharpening means comprising abrading means (31,39,34) providing a rotatable cylindrical abrading surface (34), means (32) to support a twist drill to be sharpened with its axis (X2-X2) intersecting a rectilinear generatrix of said surface (34) at an "approach" angle of generally half the point angle of the drill (4), and means (45,51,52,55,56) to vary said "approach" angle upon angular movement of the drill (4) about its axis.

Preferably the sharpening means comprises a drill holder (33) to hold a drill to be sharpened, a carrier (35) for supporting the holder for angular movement about the drill axis (X2-X2), means mounting the carrier (35) on a support for angular movement relative to the support about an axis (Z-Z) orthogonally intersecting the drill axis (X2-X2), and cam means (51/52,56) associated with said drill holder (33) such that said angular movement of the carrier-supported drill holder (33) can effect, via said cam means (51/52,56), a said relative angular movement of said carrier (35) thereby to vary said "approach" angle and enable a requisite "relief" for a land of the drill to be provided.

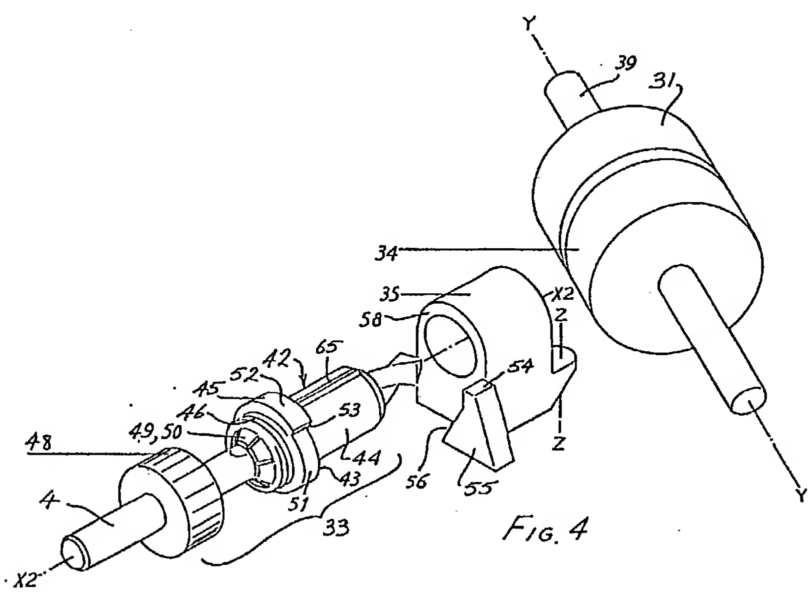


FIG. 4

GB 2 186 512 A

13 FEB 87 - 03911
DFA

2186512

1/6

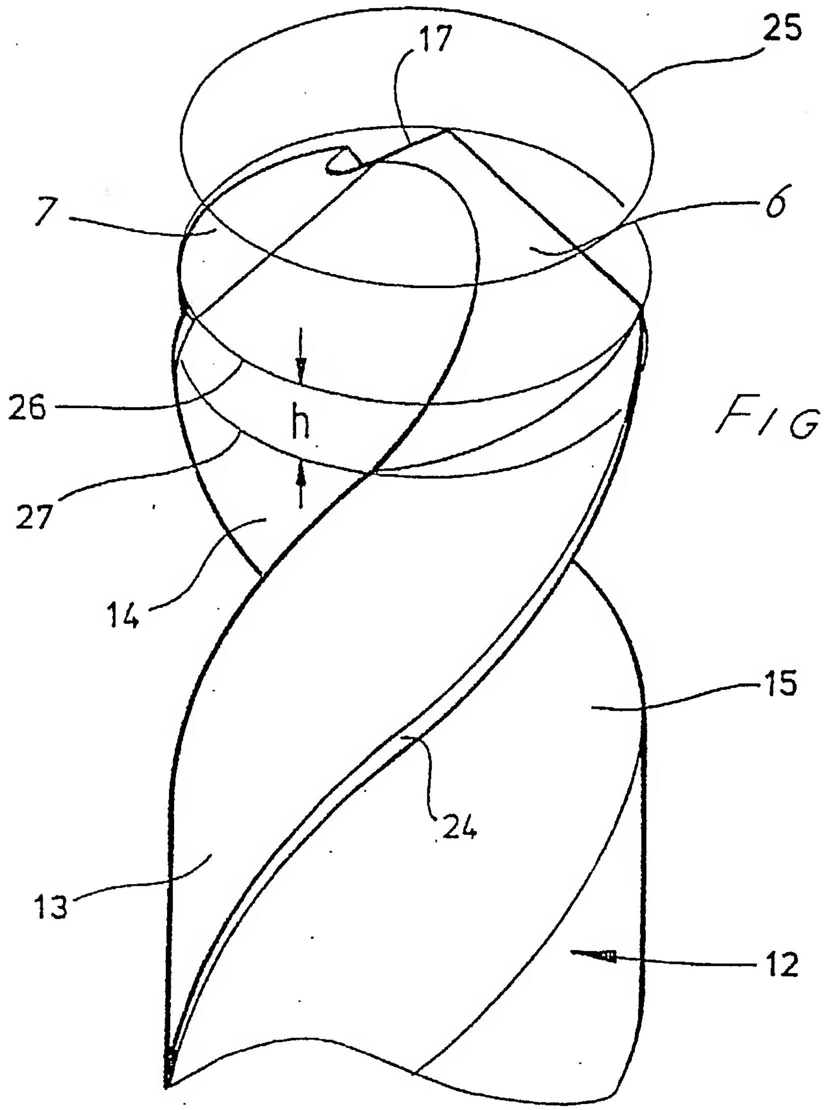


FIG. 1

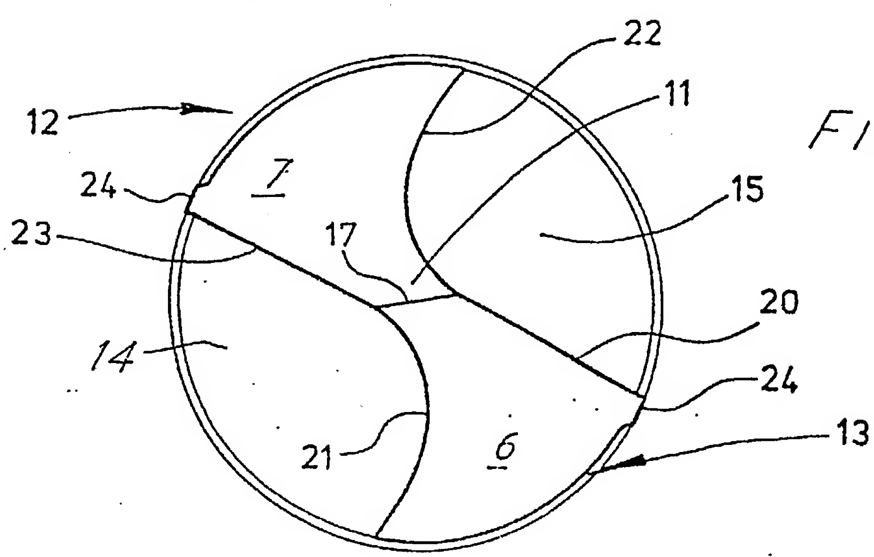


FIG. 2

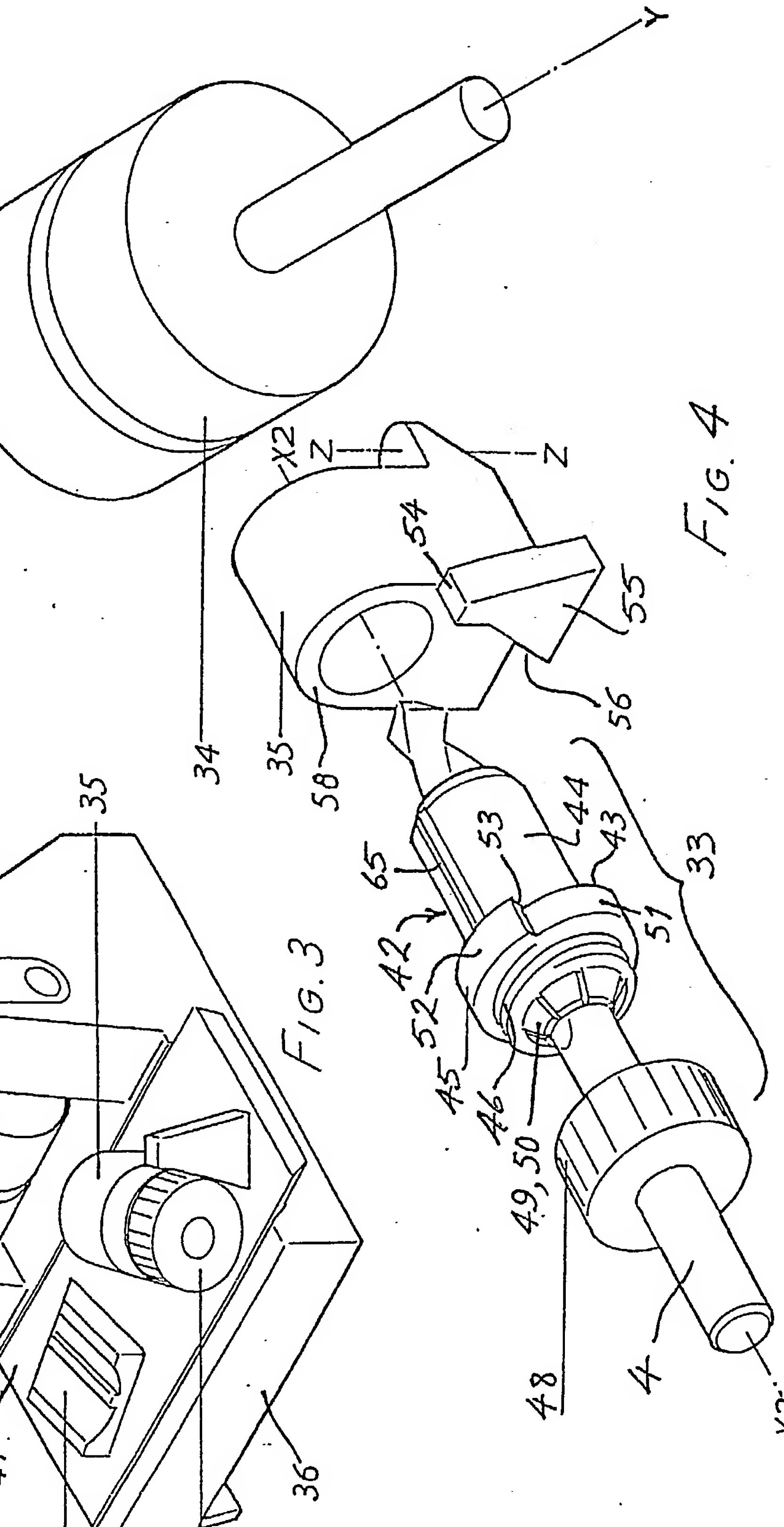

Y
Y
31
39
34
35
58
X2
Z
Z
54
55
56
44
53
43
65
A2
51
33
52
A5
A6
49,50
48
4
X2

FIG. 4

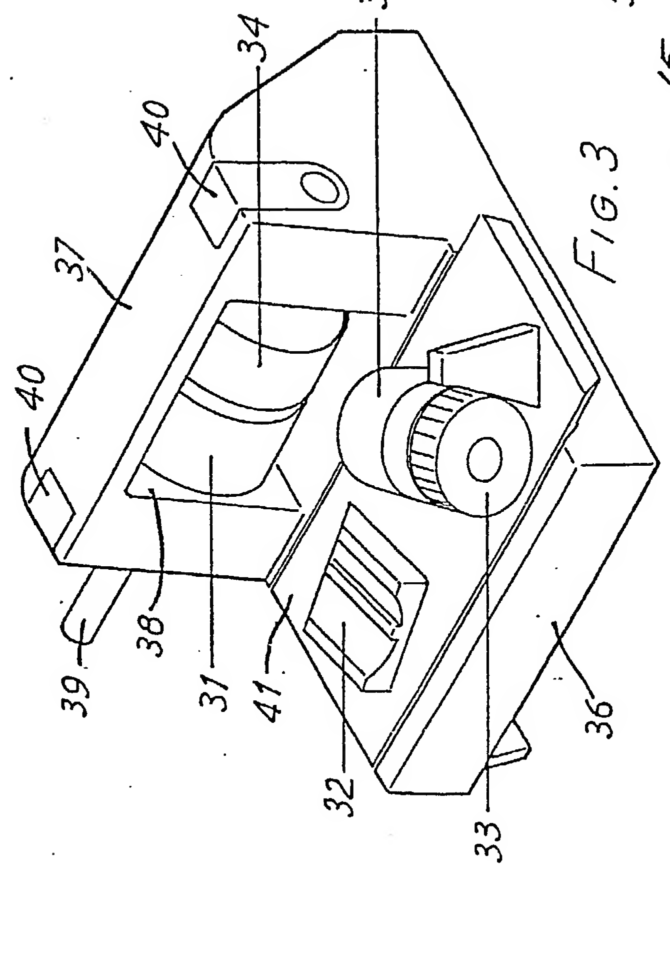

40
40
37
34
35
38
31
39
41
32
33
36

FIG. 3

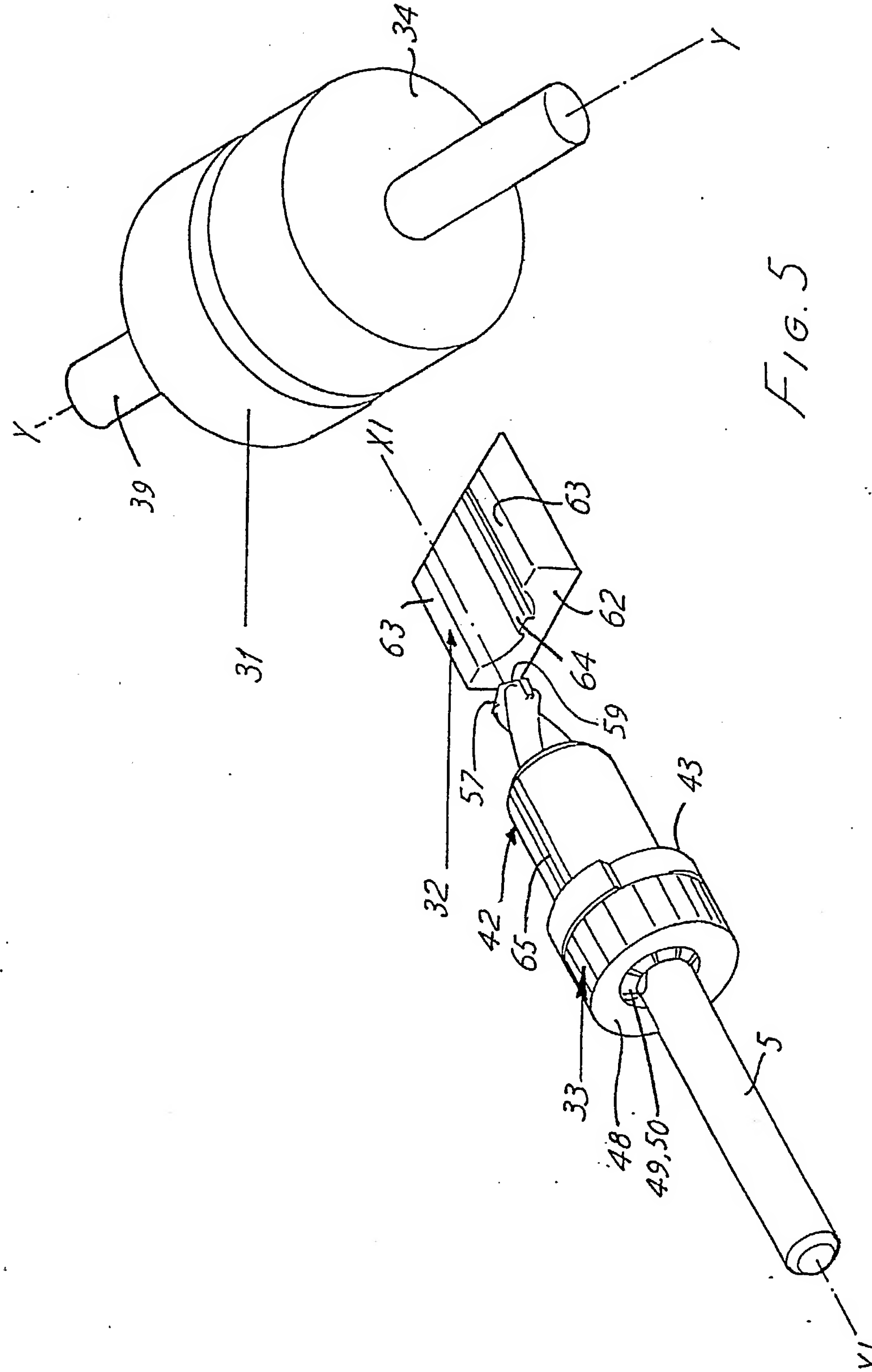
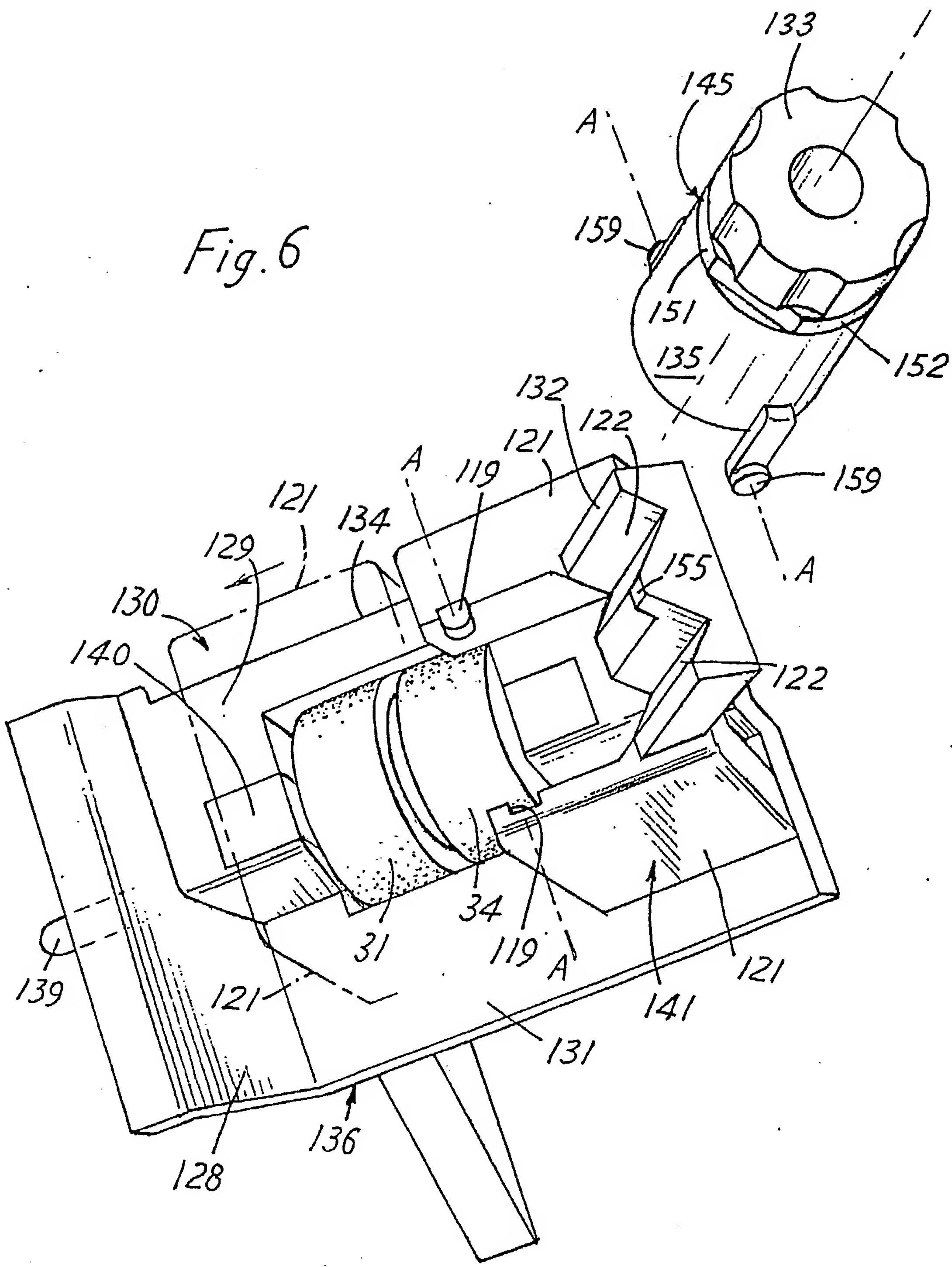


FIG. 5

Fig. 6


133
145
A
159
151
135
152
132
122
121
A
119
121
134
129
130
140
155
122
159
A
31
34
119
A
139
121
141
121
131
136
128

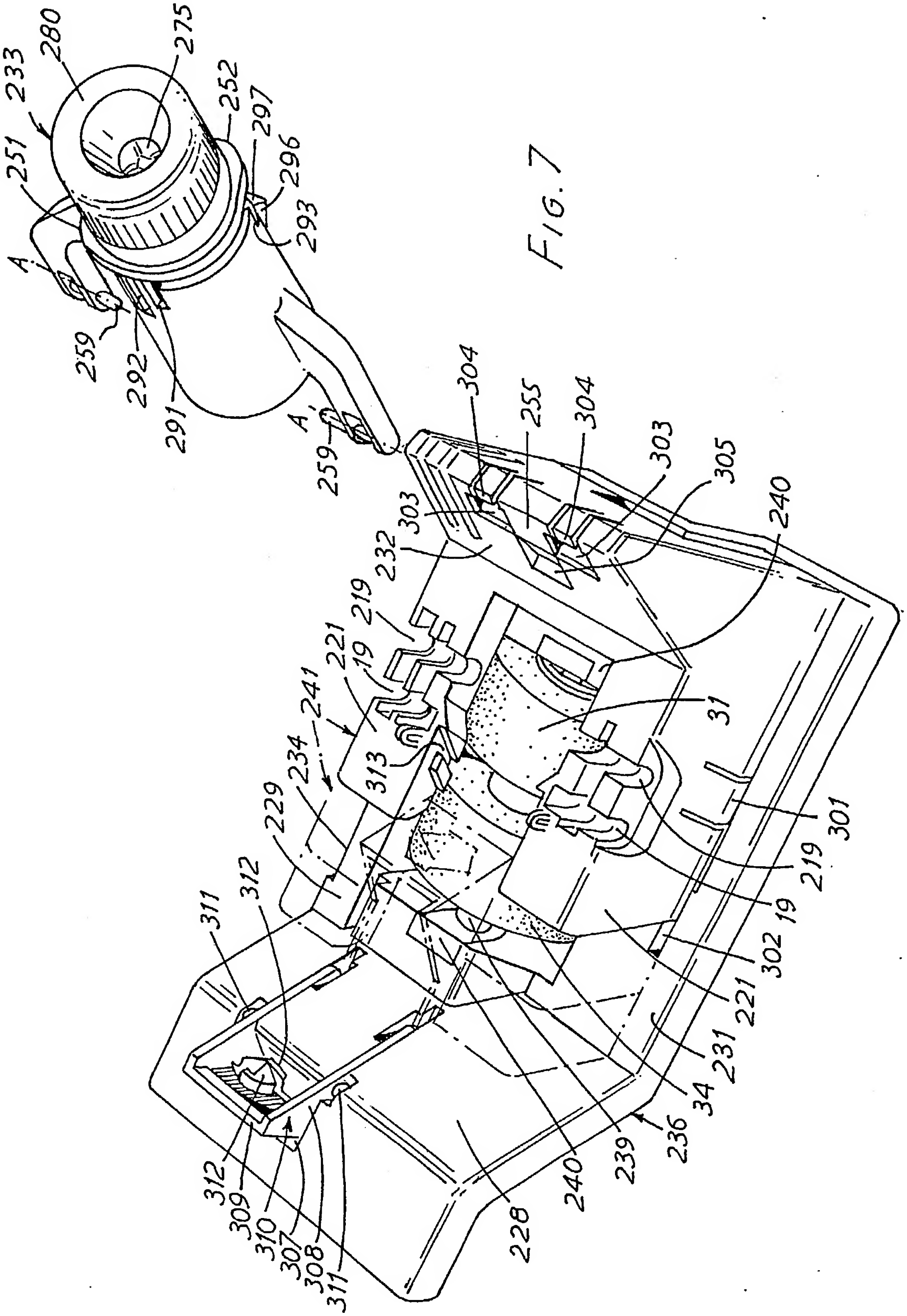

280
275
233
252
251
297
296
293
A
259
292
291
A
259
304
255
304
303
303
305
240
232
219
221
19
241
234
313
31
229
301
219
19
302
221
221
231
34
236
239
240
228
311
312
312
309
310
307
308
311

FIG. 7

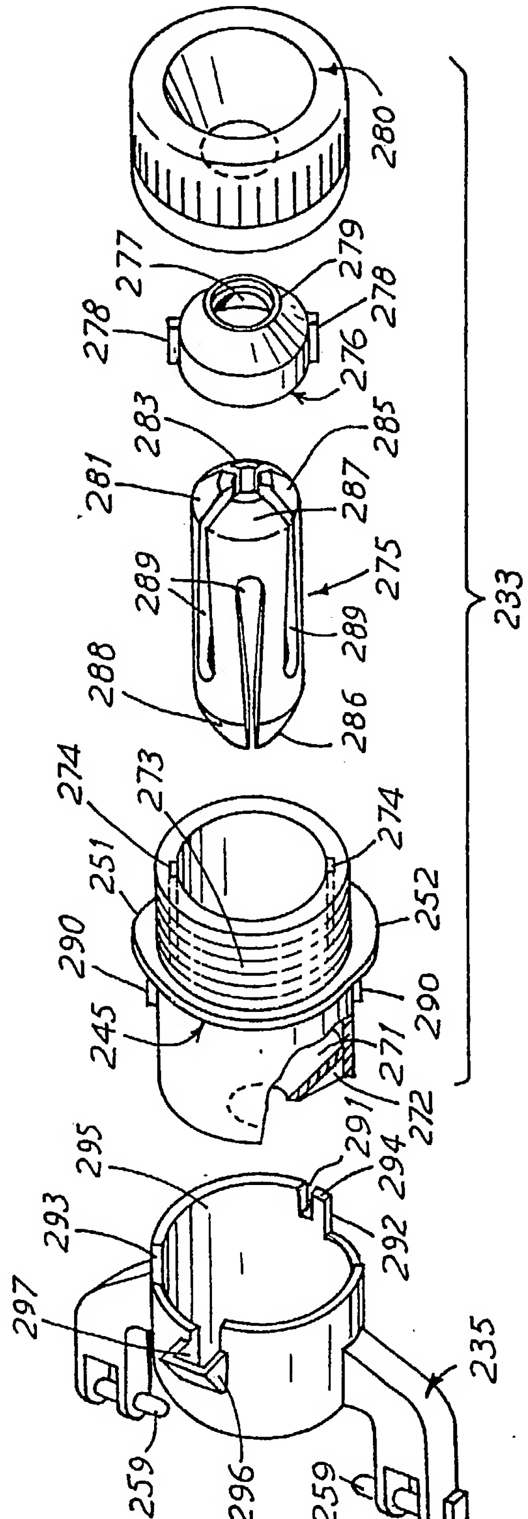

280
277
279
278
278
276
283
285
281
287
275
289
289
233
288
286
274
273
274
251
252
290
290
245
271
272
291
295
294
293
292
297
235
259
296
259

FIG. 8

SPECIFICATION

Sharpening apparatus

This invention relates to sharpening apparatus, particularly for drills.

In the accompanying drawings, *Figures 1* and *2* illustrate respectively in perspective and end elevation the tip of a common twist or fluted drill. As is well known, this comprises a central web 11 constituting the central portion of the twist drill body 12 having a cylindrical outer surface 13 formed with two deep helically extending channels 14, 15. At its tip the drill's end surface 16 is separated into two generally half-conical "lands" 6, 7 by a crest or ridge 17 of chisel edge form which intersects the longitudinal central axis of the drill body.

In use the twist drill is rotated about its longitudinal central axis anti-clockwise (as viewed in Figure 2) so that the edge 20 of land 6 provided by the intersection of this land and the spiral flute 15 is the leading edge. The trailing edge 21 of land 6 is provided by the intersection of this land and the spiral flute 14. As shown, the leading edge 20 is substantially linear between its intersection point with the chisel edge or ridge 17 and the point where it meets the outer circumference 13 of the drill body 12. This edge 20 of land 6 continues smoothly or contiguously from the intersection point as a curved trailing edge 22 of land 7. Likewise the curved trailing edge 21 of land 6 extends from the cylindrical surface 13 of the drill to the intersection point of the linear leading edge 23 of land 7 and is contiguous with that linear leading edge. The two linear leading edges 20, 23 constitute the cutting edges of the drill itself. They are continued as the helical leading edges of the cylindrical surface 13 where this surface meets the flutes 14, 15. A radially projecting "ribbon" 24 of this surface ensures that the cylindrical surface 13 is in fact slightly recessed from the hole being formed by the drill thereby to minimise frictional contact.

The precise form of the drill tip is extremely important in relation to the cutting operation to be performed by the drill. Of particular importance are the inclination of the cutting edges 20, 23 with respect to a transverse diametral plane 25 (Figure 1) of the drill tip, and the relief or inclination of the lands 6, 7 between the leading and trailing edges with respect to a plane orthogonal to the axis of the drill. The broken-line circle 26 represents a plane perpendicular to the axis of the drill and passing through the point of intersection of the leading edge 20 with the cylindrical surface 13 (the so-called "shoulder" of the cutting edge), and the broken-line circle 27 represents the corresponding intersection between the trailing edge of land 6 and the surface 13. The axial separation between planes 26 and 27 is the "fall", identified in Figure 1 by the axial distance "*h*". This fall or relief enables the cutting edge to pass relatively freely over the blind end of a bore hole being drilled, without undue frictional contact between the drill tip and the hole, and with a view to ensuring that the cutting edges alone contact the workpiece being drilled, the clearance provided corresponding to the separation between the two broken-line circles 26, 27 (i.e. the axial distance "*h*").

Although drill tips are accurately formed when new, continuous or continual use eventually blunts the cutting edges and the drill has to be (re)sharpened. This is a highly skilled operation to perform manually since it requires expert knowledge of all the required parameters of the drill and sufficient experience to know how to hold the drill at the required angle to avoid grinding flat the two generally half-conical lands 6 and 7, to preserve the chisel edge or ridge 17 separating the two generally half-conical lands 6 and 7, to maintain this edge or ridge 17 at the correct inclination to the cutting edges 20 and 23 and at the same time to preserve the inclination of the relief with respect to the planes 26 and 27. It will be appreciated that during such sharpening the drill is held at an "approach" angle, i.e. the angle between the drill axis and the abrading surface, of generally half the point angle of the drill.

Sharpening apparatus for effecting such drill (re)sharpening by non-skilled operatives is available but has hitherto been expensive and/or primarily suitable for industrial application. Examples of previously-proposed apparatus for drill re-sharpening are disclosed in UK Patent Specifications Nos. 2139930, 2078574, 1526169, 1239942, 1080502, 1038272, and 1013750.

It is therefore considered desirable to provide drill sharpening apparatus capable of use by an unskilled amateur enthusiast, i.e. apparatus which is inexpensive, is simple to operate requiring little or no operating skill, and produces a re-sharpened drill tip of acceptable overall accuracy and dimensional equivalence between the two "half-cones" or lands 6, 7.

According to a first aspect of this invention there is provided sharpening means comprising:

(a) abrading means providing a rotatable cylindrical abrading surface,

(b) means to support a twist drill to be sharpened with its axis intersecting a rectilinear generatrix of said surface generally coincident with the drill's cutting edge and at an "approach" angle of generally half the point angle of the drill, and

(c) means to vary said "approach" angle upon angular movement of the drill about its axis.

According to a second aspect of this invention there is provided sharpening means comprising:

(a) abrading means providing a rotatable cylindrical abrading surface,

(b) a drill holder to hold a drill to be sharpened,

(c) a carrier for supporting the holder for angular movement about the drill axis and with the drill's longitudinal axis intersecting a rectilinear generatrix of said cylindrical abrading surface generally coincident with the drill's cutting edge and at an "approach" angle of generally half the point angle of the drill,

(d) means mounting the carrier on a support for angular movement relative to the support about an axis orthogonally intersecting the drill axis, and

(e) cam means associated with said drill holder such that said angular movement of the carrier-supported drill holder can effect, via said cam means, a said relative angular movement of said

carrier thereby to vary said "approach" angle and provide a requisite "relief" for a land of the drill.

Preferably the axis of angular movement of the carrier is substantially tangential to the said cylindrical abrading surface. Preferably the cam means comprises a cam rotationally fast with the said drill holder, and a cam engagement member fast with said support.

Advantageously said cam comprises a pair of cam lobes located diametrically opposite one another about the drill axis.

According to a third aspect of this invention there is provided a holder device (e.g. a chuck) for an elongate member, the holder device comprising a collet having a plurality of fingers extending in opposite directions, and collet operating means to move the ends of the fingers radially to engage the elongate member at longitudinally spaced regions.

By engaging the elongate member at longitudinally spaced regions, the latter can be held with greater stability and more accurately.

Preferably said fingers extend alongside one another with adjacent fingers extending in opposite directions, i.e. alternating with one another.

Advantageously each of said fingers comprises an end portion interconnecting first and second longitudinally extending limbs, the first limb being common to the next adjacent finger to one side and the second limb being common to the next adjacent finger to the other side.

Preferably said collet operating means comprises two surfaces relatively movable longitudinally of the collet and in engagement with said fingers for effecting said radial movement, the two surfaces being relatively non-movable angularly of the collet axis. Advantageously two relatively rotatable, screw-thread co-operating parts are provided for effecting said relative movement of the two surfaces. It will be appreciated that, notwithstanding such relative rotation, the fingers of the collet are restrained against twisting by virtue of the relative angular immovability of the said two surfaces.

Preferably the collet fingers are in use urged resiliently against the direction of their radial movement. Advantageously the collet is molded of plastics material, e.g. nylon, to provide said fingers with an inherent resiliency. The collet operating means may be arranged to move the ends of the collet's fingers radially outwardly or, as is preferred, radially inwardly.

Preferably the two surfaces are frusto-conical and/or they engage frusto-conical surfaces of the ends of said fingers.

By way of non-limiting example, embodiments of this invention will now be described with reference to Figures 3 to 9 of the accompanying drawings. In these drawings:

Figure 3 is a schematic perspective view of a first embodiment of sharpening apparatus according to the present invention,

Figure 4 is a perspective "exploded" view of parts of Figure 3 for use in sharpening a twist drill,

Figure 5 is a perspective view of parts of Figure 3 shown "exploded", for use in sharpening a masonry drill,

Figure 6 is a perspective "exploded" view of a second embodiment of sharpening/grinding apparatus according to the present invention,

Figure 7 is a perspective "exploded" view of a third embodiment of sharpening/grinding apparatus according to the present invention, and

Figure 8 is a perspective "exploded" view of part of the apparatus shown in Figure 7.

The sharpening apparatus 30 of Figure 3 comprises a base structure 36 of plastics material formed integrally with, and projecting horizontally away from, a housing 37. The housing 37 has an opening 38 facing the base structure 36 and contains two separate grinding wheels 31, 34 mounted on a common shaft or spindle 39. The latter is journalled in bearings 40 provided in the housing's end walls and projects outwardly through one of the end walls. The grinding wheel 31 is a right-cylinder with its cylindrical abrading surface comprising silicon carbide. It is thus suitable for sharpening masonry drills having a tungsten carbide tip of conventional V-shaped outline. The grinding wheel 34 is a right-cylinder with its cylindrical abrading surface comprising aluminium oxide. It is thus suitable for sharpening twist drills, e.g. manufactured of high speed steel, of the conventional form described above with reference to Figures 1 and 2.

Two carriers 32, 35 of plastics material are mounted on a platform 41 which is itself mounted on the base structure 36. Each of the carriers 32, 35 is adapted to support a drill holder 33 which, when positioned in the carrier 32 or 35, will direct the axis of the drill held in the holder horizontally and such as to intersect the rectilinear generatrix of the cylindrical wheel 31 or 34 (coincident with the drill's cutting edge) respectively at an "approach" angle of generally half the point angle of the drill. The carrier 32 is positionally fixed on the platform 41 and may be formed integrally therewith of plastics material. Preferably the arrangement is such that the masonry drill axis is slightly below the horizontal plane containing the axis of spindle 39 so as to enable a 15° relief angle to be provided on the masonry drill. The carrier 35 is mounted pivotally on the platform 41, the pivot axis Z-Z (Figure 4) extending vertically so as to intersect orthogonally the axis of the drill holder 33 (when supported by carrier 35), preferably at the point of intersection of the drill axis and the grinding wheel's said rectilinear generatrix. Preferably the vertical pivot axis Z-Z is substantially tangential to the cylindrical abrading surface of grinding wheel 34; and preferably the arrangement is such that the twist drill axis is in the same horizontal plane as that containing the axis of spindle 39.

The platform 41 is releasably mounted on the base structure 36 so as to be selectively fixed thereto or be horizontally slidable with respect thereto. Devices such as detents or click stops are provided between the base structure 36 and platform 41 to restrict the platform 41 either to a fixed position on base structure 36 or to permit it to slide along base structure 36 within a range defined by two end positions. These devices are arranged such that when the platform is in its fixed condition, the drill holder 33 (with a twist drill to be sharpened held

therein) can be mounted in carrier 35 and the twist drill will engage grinding wheel 34 - and wheel 34 alone. Conveniently a plurality of such fixed positions, each fulfilling this requirement, can be provided by the detent or click stop devices so that a new fixed position is engaged on each occasion of repeated use whereby the full axial length of the wheel 34 can be step-wise utilised. These devices also provide that when the platform is in its slidable condition the selfsame drill holder (but with a masonry drill to be sharpened held therein) can be mounted in carrier 32 and the twist drill will engage grinding wheel 31 - and wheel 31 alone.

The drill holder 33 comprises a tubular outer body 42 having a hollow cylidrical section 44 extending away from one radial face 43 of a two-lobed cam member 45, an externally threaded portion 46 extending away from the other radial face (47) of the cam member 45. An internally threaded cap 48 is co-operable with the threaded portion 46 of body 42, the base of this cap having a hole therethrough and being concavely tapered on its inner surface. A tubular insert 49 is disposed within the cylindrical through-bore in body 42. The insert 49 is formed at at least one end with a plurality of longitudinal flexible fingers 50. The outer surfaces of fingers 50 are bevelled at their extremities which project from the outer body 42 adjacent its threaded portion 46.

In use, a drill to be sharpened is placed in the bore of the insert 49 whilst the latter is within body 42, the cap is placed thereon and screwed up upon threaded portion 46. The internally tapered base of cap 48 thus co-operates with the bevelled ends of the insert's fingers 50 to compress the latter into tight gripping engagement of the drill. Three inserts 49 of different internal bore diameter can be provided for selectively accommodating a wide range of drill sizes. The radial end face of cylindrical section 44 remote from cam member 45 is scored or otherwise marked with a diametral reference line, and before the cap 48 is fully screwed down on the outer body's threaded portion 46, the drill is rotated about its axis to provide that an edge (e.g. 20 or 23) of the drill is aligned to be coplanar with said diametral reference line.

Each of the two lobes 51, 52 of cam member 45 is of somewhat spiral form with its generatrix parallel to the axis of holder 33 (and hence, in use, to the drill axis). Each lobe extends over approximately 180° and radial steps 53 interconnect the minimum radial dimension of one lobe and the maximum radial dimension of the other lobe. The two radial steps 53 are coplanar with the reference line scored or marked at the distal end of body section 44. Each of the steps 53 is selectively co-operable with the horizontal top 54 of a cam engagement member 55. The cam engagement member 55 is of frusto-triangular vertical cross-section and is fixed to (e.g. molded integrally with) the platform 41 at a location such that the sloping surface 56 of cam engagement member 55 can co-operate with the lobes of cam member 45.

In use, to sharpen a twist drill (4 in Figure 4), the platform 41 is first locked in an appropriate fixed position by the detent or click stop devices. An insert 49 of appropriate internal dimensions is selected and inserted into the interior of outer body 42 of holder 33, and the cap 48 screwed lightly in position. The twist drill to be sharpened is pushed into and through the holder 33 to project from each end thereof, and is rotated until one cutting edge, say 20, is coplanar with the reference line and the steps 53 of cam member 45. The cap 48 is then tightened further to hold the drill against further rotation relative to the holder's body 42.

The holder 33 is then inserted into the carrier 35 with the surface 43 facing the surface (58) of the carrier 35 that is distal from the grinding wheel 34. The holder 33 is rotated to bring one step 53 into engagement with the horizontal top 54 of cam engagement member 55. A shim or distance piece of about 1mm thickness, e.g. a conventional plastics material credit card, is placed between surfaces 43 and 58, and the drill to be sharpened is pushed longitudinally (from its rear end), but without rotation, until its cutting edge 20 engages the grinding wheel 34. In this position, the cap 48 is then fully tightened to prevent any further movement, longitudinal or rotational, of the drill within the holder 33. The shim is then removed, the grinding wheel 34 rotated, and the holder 33 urged axially of the drill axis towards the grinding wheel and simultaneously rotated angularly to and fro about the drill axis whilst the cam member 45 is pressed against the fixed cam engagement member 55. The grinding operation is terminated when the axial clearance initially provided by the shim is taken up and the surfaces 43 and 58 abut one another.

It will be apparent that, due to the co-operating engagement between the spiral-like surface of the cam lobe 51 or 52 of cam member 45 and the sloping surface 56 of the cam engagement member 55, the carrier 35 is caused to pivot in a clockwise direction (when viewed from above) about its pivot axis Z-Z as, and in correspondence with, the rotatary movement of the drill about its axis. Thus, simple rotation of the drill about its axis causes grinding of the land 6 at a half-cone angle that is reduced progressively across land 6 from leading edge 20 to trailing edge 21.

Conveniently the co-operating cam and cam engagement members 45, 55 are arranged to provide an "approach" angle for the leading edge of a nominal 59° thereby to provide the finished drill with its desired conventional "cone angle" of 118°. The co-operation of the cam and cam engagement members 50, 55 provides an excellent approximation to the desired relief for a properly sharpened drill.

When the one land 6 has been sharpened, the drill holder is removed, turned through 180° about its axis, and re-inserted into the carrier 33 without further adjustment of the drill's position in the holder 33, and the drill holder once again rotated as before with the other cam lobe 52 or 51 in contact with sloping surface 56 of the cam engagement member 55. This "second-half" grinding operation is terminated when the axial clearance (which was provided at the outset by the shim) is taken up and the surfaces 43 and 58 again abut one another. The carrier 35 is thus again pivoted about its pivot axis

Z-Z as, and in correspondence with, the rotary movement of the drill about its axis. This thereby causes grinding of the land 7 at a half-cone angle that is reduced progressively across land 7 from leading edge 22 to trailing edge 23, and provides an excellent approximation to the desired relief for a properly sharpened drill. Thus both half-conical "lands" 6, 7 have been ground to the same leading edge angle and to the same trailing edge angle and are symmetrical about the drill axis. In effect, the arrangement is substantially that each land 6, 7 has the general form of a half cone, the two half cones being skew to one another with their axes mutually inclined at an angle corresponding to the relief angle.

To sharpen a masonry drill 5 (Figure 5) which, as is conventional, has a hardened (e.g. tungsten carbide) tip insert of V-shape cross-section provided by mutually inclined flat cutting edges 57 and 59, the platform 41 is first unlocked from its fixed condition and, by means of the detent or click stop devices, is allowed to occupy its appropriate sliding condition. An insert 49 of internal dimensions appropriate to the drill is selected and inserted into the interior of outer body 42, and the cap 48 screwed lightly in position. The masonry drill to be sharpened is pushed into and through the holder 33 to project from each end thereof, and is rotated until one edge (57 or 59) of the V is coplanar with the reference line and the steps 53 of cam member 45. The cap 48 is then tightened further to hold the drill against further rotation relative to the holder 42. The latter is then placed onto the carrier 32 with the surface 43 facing the surface (62) of the carrier 32 that is distal from the grinding wheel 31. A shim or distance piece substantially less than 1 mm thickness, e.g. a sheet or two of conventional writing paper, is placed between the surface 43 of body 42 and the surface 62 of carrier 32, and the drill to be sharpened is pushed longitudinally (from its rear end), but without rotation, until its said one V edge (57 or 59) engages the grinding wheel 31.

In this position, the cap 48 is then fully tightened to prevent any further movement, longitudinal or rotational, of the masonry drill within the holder 33. The shim is then removed, the grinding wheel 31 rotated, and the holder 33 is held rotationally stationary but urged axially of the drill axis towards the grinding wheel (with the masonry drill's edge grindingly engaged by the wheel 31) as the platform 41 slid to and fro along the base structure 36. The grinding operation is terminated when the axial clearance initially provided by the shim is taken up and the surfaces 43 and 62 abut one another.

When the one V edge 57 or 59 has been sharpened, the drill holder is removed, turned through 180° about its axis, and replaced onto the carrier 32 without further adjustment of the drill's position in the holder 33, and the drill holder once again held rotationally stationary but pushed longitudinally of the drill axis towards the grinding wheel 31 whilst the platform 41 is slid to and fro so as to grind the other V edge 59 or 57 against the grinding wheel 31. Again, the grinding operation is terminated when the axial clearance provided at the outset by the shim is taken up and the surfaces 43 and 62 again abut one another. Thus both flat edges 57 and 59 of the V-shape of the masonry drill's tip insert can be ground to the same half-angle and be symmetrical about the drill axis.

To assist in holding the holder 33 stationary against rotation in carrier 32, and yet permit it to be pushed longitudinally of its axis against the grinding wheel 31, the concave floor of the carrier 32 meets a flat top surface 63 at each side, these top faces 63 being selectively engageable by a cam step 53 (depending on which edge of the V is being ground). Alternatively, a square-section ridge 64 is provided in the bottom of carrier 32 (e.g. is molded integrally therewith) so as to be engaged by one or other of two diametrically opposed longitudinal grooves or keyways 65 provided in the outer surface of cylindrical section 44 of the holder 33, these keyways or grooves 65 being orthogonal to the plane of the cam steps 53 and of the drill reference line.

It will be appreciated that for sharpening a twist drill, the pivotal motion of carrier 35 about axis Z-Z (Figure 4) need only be of a few degrees of arc, e.g. of between 0.5° to 5°, to provide an appreciably greater lip relief angle, e.g. of between 3° to 18°. In a preferred form of the embodiment of Figures 3 to 5, a twist drill of 118° point angle (i.e. the angle between cutting edges 20, 23 when viewing the drill in side elevation) can be provided with a lip relief angle of 9° by moving the carrier 35 through an angle of approximately 3° about the axis Z-Z. As has been explained above, this angular motion about axis Z-Z is effected automatically by the cam means 45, 56 upon rotation of the holder-held drill about the drill's longitudinal axis with the holder engaged within the carrier.

It will also be appreciated that the mode of rotating the grinding wheels 31, 34 is preferably by engaging the projecting end of spindle 39 in the chuck of a conventional power tool holder (e.g. an "electric drill" as used by D.I.Y. enthusiast), the power tool resting on its side on the work bench or table upon which the base structure 36 is located. Alternatively, the spindle 39 may be belt driven from a remote motor or engine. In either case, the platform 41 may be mounted removably upon the base structure 36 so that when removed the grinding wheels 31 or 34 can be used for general abrading purposes, e.g. to re-sharpen chisels, screw-drivers, and/or other tools and implements. The base structure 36 may be provided (below platform 41) with sockets into which removable posts may be inserted to serve as rests for such general abrading.

Such alternative or additional uses are facilitated further by the embodiment of Figure 6. In this embodiment the sharpening/grinding apparatus 130 comprises a stepped base structure 136 having upper and lower levels 129, 131 and revealing a substantial angular extent of each of the two grinding wheels 31, 34. The common shaft or spindle 139 upon which these wheels 31, 34 are mounted, is journalled in bearings 140 and projects laterally outwards below a raised shield plate 128 formed integrally with the upper and lower levels 129, 131 of the base structure 136. The shield plate 128 protects

the user of the sharpening/grinding apparatus 130 against injury from the rotating chuck of the "electric drill" or other power tool (not shown) in which the spindle or shaft 139 is in use engaged. A bridge member 141 is removably mounted over the wheels 31, 34 for sliding motion over levels 129, 131 in opposite directions parallel to spindle 139. The two limbs 121 of bridge member 141 engage in slots or grooves (such as 134) provided in the upper and lower levels 129, 131 of the base structure. The bridging element across the top of the two limbs 121 comprises a carrier 132 of somewhat W-shaped cross-section. The upper end of the carrier 132 is centrally more pronounced to provide a raised frusto-triangular projection 155. The two parallel "grooves" 122 of the bridging element's W extend in directions inclined to a rectilinear generatrix of the wheel 31 or 34 coincident with the drill's cutting edge and at an "approach" angle of generally half the point angle of a drill to be sharpened.

Devices such as detents or click stops are provided between the limbs 121 of the bridge member 141 and the base structure's slots or grooves they engage. These devices are arranged such as to restrict the bridge member 141 either (a) to permit it to slide along base structure 136 within a range defined by two end positions, or (b) to any one of a plurality of fixed positions on the base structure 136.

The former case, case (a), corresponds to a position shown diagrammatically in chain-dot outline in Figure 6 and is adopted where a "four facet" percussion masonry drill is to be sharpened. For such sharpening, the masonry drill is held either manually or by a clamp (not shown) directly in a groove 122 of the W-shaped carrier 132 with the drill's tip in sliding engagement of grinding wheel 31 - and only grinding wheel 31. The carrier 132 can then be slid back and forth to sharpen one of the masonry drill's four facets against the rotating wheel 31. The drill is rotated 180° about its axis and the sharpening operation repeated with the "diametrically opposite" facet of the "four facet" masonry drill whilst the latter is held in the same groove 122. The whole sequence of operations is then repeated with the drill held in other groove 122 so as to sharpen the remaining two facets of the "four facet" percussion masonry drill.

The latter case, case (b), corresponds to the position shown in full lines in Figure 6 and is adopted where a twist drill (e.g. of high speed steel) is to be sharpened. For such sharpening the twist drill is held in a holder 133 substantially similar to holder 33 of Figures 3-5, and provided externally with a substantially similar cam 145 composed of cam lobes 151, 152. The holder 133 is also provided externally with a cylindrical extension fittingly insertable into the bore of a carrier 135. The carrier 135 is provided externally with a pair of diametrically opposite trunnion arms 159. The latter are removably engageable in recesses 119 provided in the limbs 121 of bridge member 141 such as to permit pivotal motion of carrier 135 about the common axis A-A of the trunnions and recesses 159, 119. In this position the cam 145 is engageable with the flat top of projection 155 so that the twist drill, when held in holder 133 with the latter inserted into the carrier 135, can engage the grinding wheel 34 - and grinding wheel 34 alone - and have the necessary relief ground away simply by rotating the drill about its axis, such rotation simultaneously effecting pivotal motion about the axis A-A (orthogonal to the drill axis) by co-operation between a cam lobe 151 or 152 and the cam engagement member 155.

It will be noted that the carrier 132 used for masonry drill sharpening provides the cam engagement member 155 used in twist drill sharpening.

The methods of initially aligning the twist drill's leading edge and of the shim provision for longitudinal grinding take-up, are similar in each of the embodiments of Figures 3-5 and Figure 6. In the embodiment of Figure 6, the masonry drill is held aligned simply by eye to enable the edge being sharpened to be ground to the appropriate angle.

It will be appreciated that the embodiment of Figure 6 can be readily employed for masonry drill sharpening simply by removing the parts 133 and 135, and can be readily employed for general grinding and sharpening (e.g. chisels, screw-drivers and the like) by additionally removing the bridge member 141.

A modified form of the embodiment of Figure 6 is shown in Figures 7 and 8. As seen in Figure 7, the modified sharpening/grinding apparatus comprises a stepped base structure 236 molded of glass-filled nylon in which the co-axial grinding wheels 31, 34 are mounted, a bridge member 241 also molded of glass-filled nylon and slidably mounted on the stepped base structure 236, a carrier 235 molded of glass-filled nylon with a pair of trunnion arms 259 by which the carrier is to be mounted on the bridge member 241, and a drill holder 233 for holding the drill (either a masonry drill or a twist drill) to be sharpened and for insertion into the carrier 235.

The holder 233 (see Figure 8) comprises a main, generally tubular, body 270 molded of glass-filled nylon and having a centrally apertured end wall 271 providing a frusto-concal internal surface. The external surface of end wall 271 is similarly of generally frusto-conical form but provided integrally with a diametrically extending rib 272 which, as will be explained below, provides an index mark. Towards its opposite end, the main body 270 is externally provided with an integral encompassing flange-like projection forming a cam member 245 composed of two identical, diametrically opposite, cam lobes 251, 252. Each of the two lobes 251, 252 of cam member 245 is of somewhat spiral form - with its generatrix parallel to the axis of holder 233 (and hence, in use, to the axis of the twist drill) - each lobe extending over approximately 180°. From the cam 245 to said opposite end the main body is provided externally with a male screw thread 273 and is provided internally with a pair of diametrically opposite, longitudinally extending channels or slots 274.

A collet 275 is disposed within the main body 270 to lie between the frusto-conical end wall 271 and an intermediate cap member 276. The latter is molded

of glass-filled nylon, is centrally apertured and has a frusto-conical internal surface 277 to engage the adjacent end of the collet 275. The intermediate cap member 276 has an integral pair of diametrically opposite, external ribs 278 to engage slidingly in the channels or slots 274. The bight wall of the intermediate cap member 276 has an integral centering rim 279 of circular form fitting within the circular central hole of an internally threaded, main cap member 280. The main cap member 280 is also molded of glass-filled nylon and is in screw-threaded cooperation with the screw-threaded end 273 of the main body 270. Tightening rotation of the main cap member 280 causes the intermediate cap member 276 to slide longitudinally along the slots 274 towards the end wall 271 and compress the collet 275 between the frusto-conical surfaces 271 and 277.

The collet 275 is molded of plastics material, e.g. nylon, to provide eight fingers 281-288 with an inherent resiliency resisting their radial deflection or displacement, the fingers 281-288 extending alongside one another with adjacent fingers extending in opposite directions, i.e. fingers 281, 283, 285 and 287 extend in one direction and alternate with fingers 282, 284, 286 and 288 which extend in the opposite direction. Each of said fingers 281-288 comprises an end portion of frusto-conical form interconnecting first and second longitudinally extending limbs, the first limb being common to the next-adjacent finger to one side and the second limb being common to the next-adjacent finger to the other side. The arrangement is such that slot-like spaces 289 separate the fingers from one another, and these slots interdigitate with one another. By engaging the drill at longitudinally spaced regions, the latter can be held by the holder 233 with great stability and with the drill and holder axes in accurate alignment with one another.

Furthermore, due to the inherent resiliency of the fingers 281-288 molded in the shape shown, the collet 275 is capable of holding drills of wide variation in diametral size. For example, a single collet 275 can be used to hold any drill with a diameter in the range 3mm to 9.5mm (1/8" to 3/8"). It will also be apparent that the collet 275 holds the drill at longitudinally spaced regions corresponding to the two ends of the collet, such holding being effected by relatively rotating the two relatively rotatable, screw-thread cooperating parts 273, 280 to effect longitudinal relative movement of the two frusto-conical surfaces 271, 277 and thus compress radially inwards the frusto-conical ends of the collet's fingers 281-288. It will be appreciated that, notwithstanding such relative rotation, the fingers of the collet are restrained against twisting by virtue of the relative angular immovability of the two surfaces 271, 277 due to the cooperation of the ribs 278 in slots 274.

The main body 270 of the drill holder 233 is also provided externally with an integral pair of diametrically opposite ribs 290, these ribs being located adjacent cam 245 to the other side thereof to that of the male screw thread 273. The holder's body 270 is for fitting coaxial insertion into a tubular body 295 of the carrier 235. The mouth of the tubular body 295 is provided with first and second slots 291, 292 adjacent one another and with a further slot 293 diametrically opposite them. Slot 291 is of very narrow angular extent - just sufficient to accomodate fittingly a rib 290 of the holder 233. Slot 291 is also of a depth somewhat less than the axial length of the ribs 290, the difference corresponding to the maximum depth to which material may be ground away from the tip of a twist drill being sharpened. The slot 292 is of greater angular extent and throughout of a greater, constant, depth than the slot 291. The difference in depth between slots 291 and 292 corresponds to the said maximum depth to which drill material may be ground away. The diametrically opposite slot 293 is of the same depth as slot 292 and of an angular extent equal to the aggregate angular extent of the slots 291 and 292 plus the the small finger-like portion 294 of body 295 that separates slots 291 and 292.

Below slot 293, the carrier 235 is molded integrally with an outwardly extending radial projection 296 having a recess or depression 297 formed in its upper surface. This radial projection 296 is diametrically opposite the finger-like portion 294 and extends radially outwards at right angles to the axis A-A of the pair of diametrically opposite trunnions 259.

The stepped base structure 236 (Figure 7) has an upper level 229 (located rearwardly when the apparatus is in use) and a lower level 231 (located forwardly when the apparatus is in use). The upstanding region connecting the levels 229, 231 and adjoining portions of these levels are apertured to reveal a substantial angular extent (e.g. 135°) of each of the two grinding wheels 31, 34. The common shaft or spindle 239 upon which these wheels 31, 34 are mounted, is journalled in nylon bearings 240 and projects laterally outwards below a raised shield plate 228 formed integrally with the upper and lower levels 229, 231 of the base structure 236. The shield plate 228 protects the user of the sharpening/grinding apparatus 230 against injury from the rotating chuck of the "electric drill" or other power tool (not shown) in which the spindle or shaft 239 of grinding wheels 31, 34 is in use engaged, the power tool resting on its side on the work bench or table upon which the base structure 236 is located. Alternatively, the spindle 239 may be belt driven from a remote motor or engine.

The shield plate 228 also provides a pivotal mounting for an alignment or drill setting device 310 which, in a rest or inoperative condition, lies in a recess 307 provided in the shield plate. The alignment or drill setting device comprises a pair of plate-like limbs 308 interconnected at their upper ends by an integral plate 309, the lower ends of the limbs 308 being pivotally mounted on the base structure 236 by outwardly extending trunnions. Adjacent the upper plate 309 the limbs 308 are provided with outwardly extending engagement lugs 311. The upper plate 309 is formed with a depression of generally conical form defined by two diametrically opposed, triangle-like, guide portions 312 which can cooperate with the fluted end of a conventional twist drill. It will be appreciated that the

full line view of the alignment or drill setting device 310 in Figure 7 shows the underside of the conical depression.

The bridge member 241 overlies the wheels 31, 34 and is removably mounted on the base structure 236 for sliding motion in opposite directions parallel to spindle 239. The two limbs 221 of bridge member 241 are of differing height and engage in a groove 234 provided in the rearward upper level 229 and in a stepped slot 302 provided in the forward lower level 231 of the base structure 236. An integral resilient tag 301 depending from the longer (forward) limb 221 projects into, and co-operates with, the stepped slot 302 in the lower level 231 of the base structure. The arrangement is such that the bridge member 241 cannot be lifted off the base structure when the tag 301 is engaged in the slot 302 but can be removed, e.g. by pivoting about groove 234, when the resilient tag is depressed rearwardly of the apparatus and disengaged from the slot 302. This stepped slot serves to restrict the bridge member 241 to slide along base structure 236 within first and second ranges. The first range corresponds to a position shown diagrammatically in chain-dot outline in Figure 7 and is adopted where a twist drill (e.g. of high speed steel) is to be sharpened. The second range corresponds to the position shown in full lines in Figure 7 and is adopted where a masonry drill is to be sharpened.

The bridging element across the top of the two limbs 221 comprises an upstanding inclined wall 232 molded integrally with the limbs 221. The upper portion of the inclined wall 232 provides a planar abutment surface 255 of generally rectangular outline, this abutment surface 255 being intersected by the vertical plane containing the axis of wheels 31, 34. To each side of abutment surface 255 the wall 232 is provided with a rectangular aperture 303 surmounted by a depending resilient hook 304 that is molded integrally with the wall 232. A recess 305 of generally rectangular form is molded into the wall 232 below the abutment surface 255.

For sharpening either a masonry drill or a twist drill, the drill is inserted into the holder 233 to extend therethrough with the drill's cutting edges (20, 23 for a twist drill 4, or 57, 59 for a masonry drill 5) in radial alignment with the index ribs 272. The holder is then inserted into the main body 295 of carrier 235 with one of the holder's ribs 290 engaged fittingly in the carrier's first slot 291 whereby the holder and carrier are held against relative rotation.

The carrier's trunnion arms 259 are removably engageable, selectively, in either a first set 19 or a second set 219 of recesses provided in the limbs 221 of bridge member 241, and in each case such as to permit pivotal motion of carrier 235 about the common axis A-A of the trunnions. The pivot axis A-A extends horizontally so as to intersect orthogonally the axis of the drill holder 233 (when supported by carrier 235), preferably at or adjacent to the point of intersection of the drill axis and the rectilinear generatrix of grinding wheel 31 or 34, depending on whether the trunnion arms 259 are engaged in the first or second set of recesses 19 or 219. Preferably the pivot axis A-A is substantially tangential to the cylindrical abrading surface of the grinding wheel 31 or 34 (again depending on whether the trunnion arms 259 are engaged in the first or second set of recesses 19 or 219).

The recesses 219 (shown schematically in Figure 7) are arranged to receive the trunnions 259 in any one of three fixed fore-and-aft positions, the most forward and rearward positions being for use when sharpening the four facets of a "four facet" percussion masonry drill, and the intermediate position being for use when sharpening the two facets of a conventional "two facet" masonry drill (with the drill axis in a vertical plane offset forwardly of the vertical plane through the spindle 239).

For sharpening a conventional "two-facet" masonry drill, the carrier's trunnion arms 259 are engaged in the recesses 219 in the intermediate fixed position they provide, and the bridge member 241 is moved rightwards (when viewed as in Figure 7) to the second range of slot 302. The masonry drill, loosely held by the holder 233 that is mounted in carrier 235, is then pushed down, without rotation, to engage the surface of grinding wheel 31. The holder 233 is then removed and the drill advanced manually a further small distance (e.g. up to approximately 1mm). The cap 280 is then fully tightened to operate the collet 275 and cause it to clamp the drill tightly within the holder 233 whilst ensuring that the cutting or leading edges of the drill remain aligned with the index ribs 272, and the holder 233 is then re-inserted into into the carrier 235 with the slot 291 again accomodating a rib 290.

The mode of cooperative engagement between the trunnions 259 and the recesses 219 is such that, with the engagement in the said intermediate fixed position, the colinear axes of the masonry drill and the tubular body 295 of holder 233 are offset forwardly from, and parallel to, the vertical plane containing the axis of spindle 239, and such that this non-zero offset provides for the sharpening of a conventional "two-facet" masonry drill at the usual facet incline of 15° to the horizontal. The engagement is effected with the carrier's radial projection 296 directed leftwards (as viewed in Figure 7) so that, by rocking the carrier clockwise about the trunnion axis, the tubular body 295 can abut against the camming surface 255. In this position the "two facet" masonry drill in holder 233 is held irrotatably in the tubular body 295 of carrier 235 by the interengagement of rib 290 in slot 291; the colinear axes of the drill, holder 233 and tubular body 295 of carrier 235 are inclined to a rectilinear generatrix of the grinding wheel 31 coincident with the drill's cutting edge and at an "approach" angle of half the point angle of the masonry drill to be sharpened; and a tangent to the wheel 31 at that rectilinear generatrix is inclined to the horizontal at an angle of 15°.

The spindle 239 of grinding wheels 31, 34 is then rotated and the bridge member 241 moved to and fro (right and left as viewed in Figure 7) to sharpen one facet of the "two facet" masonry drill against the rotating wheel 31. The holder 233 is then withdrawn, rotated through 180°, re-inserted into the carrier 235 with the slot 291 accomodating the opposite rib 290, and (with the carrier located in the same position) the

bridge member 241 is again moved to and fro over the base structure 236 to sharpen the other facet of the "two facet" masonry drill.

If the masonry drill is of the "four-facet" percussion type having each "edge" 57, 59 provided by two mutually inclined surfaces (i.e. each "edge" 57, 59 is in the form of a tick or a V), then the trunnion arms 259 are initially inserted into the most forward fixed position they can adopt in the recesses 219. In this trunnion-engaged condition the colinear axes of the percussion masonry drill and the tubular body 295 of holder 233 are offset forwardly from, and parallel to, the vertical plane containing the axis of spindle 239, and such that this non-zero offset provides for the sharpening of a conventional "four-facet" percussion masonry drill at the usual main facet incline in the range of 25 to 45° to the horizontal.

With the trunnions 259 thus engaged, the carrier 235 is pivoted about the trunnion axis A-A until the carrier's outwardly extending radial projection 296 extends into the respective rectangular aperture 303 in wall 232. Thereupon, the recess or depression 297 in the upper surface of projection 296 becomes engaged by the depending resilient hook 304 molded integrally with the wall 232 above the rectangular aperture 303. In this position the percussion masonry drill in holder 233 is held irrotatably in the tubular body 295 of carrier 235 by the interengagement of rib 290 in slot 291, the carrier 235 is held fast with the bridging member 241 (by the interengagement of hook 304 in recess or depression 297), the colinear axes of the drill, holder 233 and tubular body 295 of carrier 235 are inclined to a rectilinear generatrix of the grinding wheel 31 coincident with the drill's cutting edge and at an "approach" angle of half the point angle of the masonry drill to be sharpened, and a tangent to the wheel 31 at that rectilinear generatrix is inclined to the horizontal at said angle in the range of 25 to 45°.

The spindle 239 of grinding wheels 31, 34 is then rotated and the bridge member 241 moved to and fro (right and left as viewed in Figure 7) to sharpen one face of the "four facet" percussion masonry drill against the rotating wheel 31. The holder 233 is then withdrawn, rotated through 180°, re-inserted into the carrier 235 with the slot 291 accomodating the opposite rib 290, and (with the carrier located in the same position) the bridge member 241 is again moved to and fro over the base structure 236 to sharpen the "diametrically opposite" facet of the "four facet" percussion masonry drill.

To sharpen the other two inclined surfaces of the "four facet" percussion masonry drill, the whole procedure is repeated but with the carrier 235 re-located with its trunnions 259 engaged in the most rearward possible engagement position of the recesses 219, and with the recess or depression 297 in the upper surface of projection 296 engaged by the other depending resilient hook 304 molded integrally with the wall 232 above the rearward one of the rectangular apertures 303. In this rearward trunnion-engaged position, the colinear axes of the masonry drill and of the tubular body 295 of holder 233 are offset rearwardly (as viewed in Figure 7) from, and parallel to, the vertical plane containing the axis of spindle 239, and such that this non-zero offset provides for the sharpening of these remaining two facets of the percussion masonry drill at a facet incline in the range of 25 to 45° to the horizontal. Conveniently, sharpening of the first two facets and of the second two facets is such as to provide all four facets with the same angular incline, e.g. of approximately 30°, to the horizontal.

For sharpening a twist drill, the same holder 233 and the same carrier 235 are used, but in this case the trunnion arms 259 are engaged in recesses 19 to render the cam 245 engageable with the flat abutment surface 255 of the bridge member's upstanding wall 232. The bridge member 241 is moved leftwards (as viewed in Figure 7) to the first range of slot 302 to adopt the position shown in chain-dot outline in Figure 7. The drill alignment or setting device 310 is then lowered, i.e. pivoted downwards, until its two guide portions 312 rest upon the grinding wheel 34 and with the lugs 311 engaged in slots 313 provided therefor in the inner faces of the bridging member's limbs 221. The drill alignment or setting device 310 is thus engaged with the bridging member 241.

Initially the twist drill is inserted into the holder 233 and the main cap 280 is partially tightened until the drill is held by the collet but can still be readily moved with respect to the holder. The holder is then inserted fittingly into the main body 295 of carrier 235 with one of the holder's ribs 290 entering into the carrier's first slot 291. In this position the colinear axes of the twist drill and the holder 233 are then in the same vertical plane through the axis of spindle 239 of the wheels 31, 34 (i.e. they are not offset therefrom) and are inclined to a rectilinear generatrix of the grinding wheel 34 generally coincident with the drill's cutting edge (or with the line of contact between the drill and the cylindrical abrasive surface of the grinding wheel) at an "approach" angle of generally half the point angle of the twist drill to be sharpened.

The drill is then advanced to contact the wheel 34, and turned gently clockwise about the drill axis to engage the guide portions 312 of device 310. The latter ensure that the drill's cutting or leading edges are correctly aligned parallel to the grinding wheel axis and in the vertical plane containing the drill axis and the axis of the grinding wheels. The main cap 280 is fully screwed up to cause collet 275 to hold the twist drill tightly in the holder 233, and the holder 233 is then removed to check that the index ribs 272 are correctly aligned with the drill's leading or cutting edges. The drill alignment or setting device 310 is then restored to its upper, inoperative or rest position, the grinding wheels 31, 34 are rotated, and the holder 233 re-inserted into the tubular body 295 of carrier 235 with a rib 290 entering the slot 292 of the carrier adjacent the finger-like portion 294.

The twist drill can then have the necessary relief ground away by simply rotating the drill either unidirectionally or back and forth about its axis through the angle defined by slot 292. Such rotation simultaneously effects a corresponding pivotal motion of the twist drill about the axis A-A

(orthogonal to the drill axis) by co-operation between a cam lobe 251 or 252 and the cam engagement surface 255 of inclined wall 232. Thus, a simple rotation of the twist drill about its axis causes grinding of land 6 of the drill tip at a half-cone angle that is reduced progressively across land 6 from the drill tip's leading edge 20 to trailing edge 21. Moreover it will be apparent that the relief *h* provided to the land 6 of the drill tip is solely dependent on the cam-induced angular movement of the carrier about the axis A-A orthogonal to the drill axis due to the interaction of the cam 245 and surface 255. Grinding of the drill "land" proceeds until the free end of rib 290 in slot 292 abuts against the bottom of slot 292 so as to prevent further longitudinal movement of the twist drill held in the holder 233.

In this way it is possible to sharpen one half of the twist drill against the rotating wheel 34. The other half of the twist drill can then be sharpened by withdrawing the holder 233, rotating it through 180°, re-inserting it into the carrier 235 (located in the same position) with the slot 292 accomodating the opposite rib 290 and with the holder's opposite cam lobe 252 or 251 engaging surface 255, and then again simply rotating the drill about its axis through the angle defined by slot 292.

Thus both half-conical "lands" 6, 7 are ground to the same leading edge angle and to the same trailing edge angle and are symmetrical about the twist drill axis. In effect, the arrangement is substantially that each land 6, 7 has the general form of a half cone, the two half cones being skew to one another with their axes mutually inclined at an angle corresponding to the relief angle.

Whilst the twist drill is being sharpened, the outwardly extending radial projection 296 is received by the generally rectangular recess 305 in wall 232 below the wall's planar abutment surface 255, and therefore does not impede the latter's engagement by the cam lobes 251, 252. The lateral engagement of the external sides of the projection 296 and the sides of the rectangular recess 305 in wall 232 aids in holding the twist drill in the vertical plane containing both the drill axis and the axis of spindle 239 and wheels 31, 34 throughout resharpening of the twist drill.

It will be noted that, as compared with the embodiment of Figure 6, the embodiment of Figures 7 and 8 provides a simplified method of initially aligning the twist drill's leading edge, i.e. by the alignment or setting device 310, and also provides for a simplified longitudinal grinding take-up by having the slots 291 and 292 in carrier 235 of differing depths, the depth of slot 292 being constant throughout its angular extent. Furthermore, by providing for the same holder and carrier to be used for a twist drill, a conventional "two-facet" masonry drill and for a "four-facet" percussion masonry drill, sharpening of each can be readily obtained with appropriate accuracy.

It will be appreciated that, like the embodiment of Figure 6, the embodiment of Figures 7 and 8 can be readily employed for general grinding and sharpening (e.g. chisels, screw-drivers and the like) by simply disengaging tab 301 from slot 302 and removing the bridge member 141 to reveal substantial angular extents of both grinding wheels 31, 34.

It will also be appreciated that, in both the embodiment of Figure 6 and in the embodiment of Figures 7 and 8, for sharpening a twist drill, the pivotal motion of carrier 135 or 235 about axis A-A (Figure 6 or Figure 7) need only be of a few degrees of arc, e.g. of between 0.5° to 5°, to provide an appreciably greater lip relief angle, e.g. of between 3° to 18°. In preferred forms of these two embodiments, a twist drill of 118° point angle (i.e. the angle between cutting edges 20, 23 when viewing the drill in side elevation) can be provided with a lip relief angle of 9° by having cam 145 or 245 move the carrier 135 or 235 through an angle of approximately 3° about the axis A-A. As has been explained above, this angular motion about axis A-A is effected automatically by the cam means 145, 155 or 245, 255 upon rotation of the holder-held twist drill about the drill's longitudinal axis with the holder engaged within the carrier. If desired the lip relief angle can in use be altered from that normally provided by the apparatus. This is achieved by setting the line of the twist drill's cutting edges a few degrees (e.g. 0 to 5°) to either side of the index marks or ribs (272 in Figure 8) with which those cutting edges are normally aligned, final tightening of the collet being performed with the drill in this alternative positional setting.

CLAIMS

1. Sharpening means comprising abrading means providing a rotatable cylindrical abrading surface, and means to support a twist drill to be sharpened, characterised in that said support means are to support a twist drill with its axis intersecting a rectilinear generatrix of said rotatable abrading surface at an "approach" angle of generally half the point angle of the drill, and further characterised by means to vary said "approach" angle upon angular movement of the drill about its axis.

2. Sharpening means comprising abrading means providing a rotatable cylindrical abrading surface, a drill holder to hold a drill to be sharpened, and a carrier for supporting the holder during drill sharpening,

characterised that said carrier is for supporting the holder for angular movement about the drill axis and with the drill's longitudinal axis intersecting a rectilinear generatrix of said cylindrical abrading surface at an "approach" angle of generally half the point angle of the drill,

means are provided for mounting the carrier on a support for angular movement relative to the support about an axis orthogonally intersecting the drill axis, and

cam means are associated with said drill holder such that said angular movement of the carrier-supported drill holder can effect, via said cam means, a said relative angular movement of said carrier thereby to vary said "approach" angle and enable a requisite "relief" for a land of the drill to be provided.

3. Sharpening means according to Claim 2, characterised in that the axis of angular movement of the carrier is substantially tangential to the said cylindrical abrading surface.

4. Sharpening means according to Claim 2 or Claim 3, characterised in that the cam means comprises a cam rotationally fast with the said drill holder, and a cam engagement member fast with said support.

5. Sharpening means according to Claim 4, characterised in that said cam comprises a pair of cam lobes located diametrically opposite one another about the drill axis.

6. Sharpening means according to any one of Claims 2 to 5, characterised in that said abrading means provides first and second cylindrical abrading surfaces, the first cylindrical abrading surface being suitable for sharpening a twist drill held in said drill holder and the second cylindrical abrading surface being suitable for sharpening a masonry drill held in the selfsame drill holder.

7. Sharpening means according to Claim 6, characterised in that, for sharpening a masonry drill, the said drill holder is supported by the selfsame carrier and such that the tip of the masonry drill can engage said second cylindrical abrading surface.

8. Sharpening means according to Claim 6 or Claim 7, characterised in that the first and second cylindrical abrading surfaces are provided by first and second grinding wheels mounted coaxially on a common spindle.

9. Sharpening means according to Claim 8, wherein said wheels project through an aperture in a platform, a bridge member is mounted on the platform for sliding motion parallel to the spindle axis, and the carrier for the drill holder is mounted on the bridge member.

10. Sharpening means according to Claim 9, wherein the bridge member is mounted removably on said platform, the latter being shaped such that when the bridge member is removed the said grinding wheels become accessible for manual sharpening and/or re-grinding of other tools, implements and the like.

11. Sharpening means according to Claim 9 or Claim 10, wherein said carrier is removably mounted on the bridge member.

12. Sharpening means according to any one of Claims 9 to 11, wherein said carrier is removably mounted on the bridge member in selectively first and second positions spaced apart longitudinally of the axis of said grinding wheels, to enable respectively a twist drill (held in a said carrier-supported drill holder) to engage said first grinding wheel, and a masonry drill (held in a said carrier-supported drill holder) to engage said second grinding wheel.

13. Sharpening means according to Claim 12, wherein said carrier is removably mounted on the bridge member in selectively said first position, said second position, and third and fourth positions, said first position enabling said twist drill engagement in a common plane through the spindle axis, the drill axis and said rectilinear generatrix of the cylindrical abrading surface coincident with the twist drill's cutting edge, said second position enabling said masonry drill engagement to one side of said common plane of the first position and spaced therefrom by a first distance, said third position enabling said masonry drill engagement to the same side of said common plane of the first position and spaced therefrom by a second distance greater than the first distance, and said fourth position enabling memory drill engagement to the other side of said common plane of the first position and spaced therefrom by said second distance.

14. Sharpening means according to any one of Claims 2 to 13, characterised in that the holder comprises a collet having a plurality of fingers extending in opposite directions, and collet operating means to move the ends of the fingers radially to engage the elongate member at longitudinally spaced regions.

15. Sharpening means according to Claim 14, characterised in that said fingers extend alongside one another with adjacent fingers extending in opposite directions.

16. Sharpening means according to Claim 14 or Claim 15, characterised in that each of said fingers comprises an end portion interconnecting first and second longitudinally extending limbs, the first limb being common to the next adjacent finger to one side and the second limb being common to the next adjacent finger to the other side.

17. Sharpening means according to any one of Claims 14 to 16 characterised in that said collet operating means comprises two surfaces relatively movable longitudinally of the collet and in engagement with said fingers for effecting said radial movement, the two surfaces being relatively non-movable angularly of the collet axis.

18. Sharpening means according to Claim 17, characterised in that two relatively rotatable, screw-thread co-operating parts are provided for effecting said longitudinal relative movement of the two surfaces.

19. Sharpening means according to any one of Claims 14 to 17 characterised in that the collet fingers are in use urged resiliently against the direction of their radial movement.

20. Sharpening means according to any one of Claims 14 to 19 characterised in that the collet is molded of plastics material to provide the collet fingers with an inherent resiliency.

21. Sharpening means according to any one of Claims 14 to 20 characterised in that the collet operating means are arranged to move the ends of the collet's fingers radially inwardly.

22. Sharpening means according to any one of Claims 14 to 20 characterised in that the collet operating means are arranged to move the ends of the collet's fingers radially outwardly.

23. Sharpening means according to any one of Claims 14 to 22 characterised in that the said two surfaces are frusto-conical.

24. Sharpening means according to any one of Claims 14 to 23 characterised in that the said two surfaces engage frusto-conical surfaces of the ends of said fingers.

25. Sharpening means substantially as herein

described with reference to and/or as illustrated in Figures 3 to 5, Figure 6, or Figures 7 and 8 of the accompanying drawings.

Printed for Her Majesty's Stationery Office by
Croydon Printing Company (UK) Ltd, 6/87, D8991685.
Published by The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.